The dynamic course of peripartum depression across pregnancy and childbirth

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ABSTRACT

Objective: Peripartum depression (PPD) pertaining to depression in pregnancy and postpartum is one of the most common complications around childbirth with enduring adverse effects on mother and child health. Although psychiatric symptoms may improve or worsen over time, relatively little is known about the course of PPD symptoms and possible fluctuations.

Methods: We applied a person-centered approach to examine PPD symptom patterns across pregnancy and childbirth. 824 women were assessed at three time points: first trimester (T1), third trimester (T2), and again at eight weeks (T3) postpartum. We assessed PPD symptoms, maternal mental health history, and childbirth variables.

Results: Growth mixture modeling (GMM) analysis revealed four discrete PPD symptom trajectory classes including chronic PPD (1.1%), delayed (10.2%), recovered (7.2%), and resilient (81.5%). Delivery complications were associated with chronic PPD but also with the recovered PPD trajectory class. History of mental health disorders was associated with chronic PPD and the delayed PPD class.

Conclusion: The findings underscore that significant changes in a woman's depression level can occur across pregnancy and childbirth. While a minority of women experience chronic PDD, for others depression symptoms appear to significantly alleviate over time, suggesting a form of recovery. Our findings support a personalized medicine approach based on the woman's symptom trajectory. Future research is warranted to identify the mechanisms underlying modifications in PPD symptoms severity and those implicated in recovery.

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1. Introduction

Pregnancy and childbirth are significant life events that are typically viewed as happy. Research as exists reveals that these life-transforming events are complex and may have positive (Taubman–Ben-Ari et al., 2018) but also negative psychological effects. Women can suffer from a range of psychological disturbances during this time (Ayers et al., 2016). Childbirth-related non-psychotic depression is regarded as one of the most frequent complications of pregnancy, which may involve maternal suicide and/or infanticide (Lindahl et al., 2005). An estimated 10–15% of women are affected annually although PPD rates are probably under-reported (Centers for Disease and Prevention, 2008; O'Hara and McCabe, 2013). Similar prevalence is reported in Finland (Tammentie et al., 2002). Maternal depression may adversely affect the offspring (Stuart-Parrigon and Stuart, 2014). The World Health Organization has recently advocated for a depression screening as part of routine peripartum obstetrics care (O'Connor et al., 2016; Practice, 2010; Siu et al., 2016). Clearly, childbirth-related depression is a public health concern requiring scientific attention.

Although postpartum depression is a time-honored diagnosis, the recent DSM-5 classification lists the diagnosis as peripartum depression (PPD) instead, in recognition of cases in which depression may have its onset even prior to parturition. Research has suggested that rates of depression in pregnancy tend to be higher than postpartum depression alone (Banti et al., 2011; Evans et al., 2001). In accord with the World Health Organization (2010), PPD is recognized as a depressive episode with vulnerability up to 12 months postpartum.

Data on the course of PPD symptoms from early pregnancy through childbirth is sparse, and it has been suggested that the symptoms follow various patterns over time (e.g., McCall-Hosenfeld et al., 2016). In longitudinal non-postpartum studies clear individual differences and heterogeneity in adjustment to major life evens have been consistently observed. There could be a non-pathological stable pattern of resilience response as well as gradual recovery and delayed reactions (Bonanno et al., 2005; Bonanno and Diminich, 2013; Dekel et al., 2014). The findings support Bonnano's (Bonanno, 2004) theory of the various symptom responses to significant life events and underscores the heterogeneity of long-term outcomes.

Accordingly, it is expected that at least four trajectories of PPD symptoms would emerge. A stable symptom trajectory suggests elevated chronic PPD symptoms in pregnancy and continued elevated symptoms following parturition. As studies indicate, endorsement of PPD during pregnancy is a significant risk factor for experiencing continuing PPD following childbirth (Vliegen et al., 2014). A mirroring image would reveal absence of PPD and resilient outcomes manifested in a stable trajectory of healthy postpartum adjustment with minimal or no symptoms. An opposing perspective would advocate for variability in PPD symptoms over time. In clinical interviews, women report experiencing PPD either during pregnancy or during the postpartum period but not during both (Kumar and Robson, 1984). This may be due to childbirth induced rapid physiological changes and traumatic deliveries which may interfere with postpartum adjustment and result in a delayed PPD onset (Dekel et al., 2017). Alternatively, PPD symptoms may dramatically improve over time in a pattern of recovery. Hormonal boosts in the immediate postpartum period may lower maternal distress and facilitate positive perception of the peripartum period to allow for reproduction and offspring care (Bennett et al., 2004; Stern, 1995).

The possibility of distinct trajectories of PPD symptoms across childbirth raises the question as to whether there are trajectory-specific risk factors. Knowledge of the symptom trajectories and associated predictors would help minimize possible false positive cases and misdiagnoses of normality (Meijer et al., 2014). Identifying steady cases of PDD, for example, may allow targeting secondary preventive interventions to modify the trajectory of the mother and protect the child at risk.

Traditional research methods to examine psychological adjustment

and mental health outcomes over time assume a single homogeneous distribution of change (Duncan and Duncan, 2004). Accordingly, the majority of longitudinal studies of community samples reveal that on average, PPD symptoms decrease between pregnancy and the postpartum period (Banti et al., 2011; Diaz et al., 2007; Smith and Howard, 2008; Whisman et al., 2011). This kind of variable-centered approach often relies on changes in raw or residual scores to identify global symptom patterns across sample trends (Bergman and Magnusson, 1997). It has been argued that trajectory of symptom change produced by average scores often depicts a pattern that is not actually represented in the data (Bonanno et al., 2013). Instead, so-called person-centered approaches are becoming increasingly popular for conducting symptom trajectory analysis of longitudinal data. This approach assumes homogeneous subpopulations within the larger heterogeneous population and can thus be useful for the identification of meaningful sub-groups or classes of individuals (Bonanno and Diminich, 2013). The focus is on inter-individual differences in intra-individual change (Muthen and Muthen, 2000; Wickrama et al., 2008).

Accordingly, recent studies suggest that responses to pregnancy and childbirth are heterogeneous and can be better explained by a set of longitudinal trajectories rather than a single over-simplified symptom response (Guyon-Harris et al., 2016; Luoma et al., 2015; Vänskä et al., 2011). These studies have relied heavily on examining postpartum symptom patterns (Giallo et al., 2014; Oh et al., 2016). Some focus on the course of PPD during pregnancy (Truijens et al., 2017); but data on symptom trajectory assessed at more than one prenatal assessment and following parturition, which is a period of anticipated changes, is limited. To the best of our knowledge, no study has attempted to capture the course of PPD symptoms from the very early gestation through the early postpartum period.

In the present study, we followed a community sample of pregnant women and employed a person-centered approach to assess PPD symptoms over time. We set out to explore the various patterns of depression symptoms throughout the very early gestation and postpartum period and their associated discrete characteristics.

2. Methods

2.1. Sample

This study is part of the Kuopio Birth Cohort (KuBiCo) project initiated in 2012. This birth Cohort (KuBiCo, www.kubico.fi) is aimed at examining the effect of combined multi-factors on the health status of mother and child. It will generate new knowledge by integrating clinical and analytical data. The final database is planned to include 10,000 mother-child pairs. All pregnant women who are expected to give birth in Kuopio University Hospital (KUH) in the Finnish county Northern Savo are eligible to participate. This hospital is one of the five university hospitals in Finland which services almost one million inhabitants in Eastern and Central Finland. There is no study exclusion criteria and no participation fee compensation is offered in accord with Finnish law. Candidates are recruited during their routine first trimester visit at the prenatal clinic primary health care personnel or midwifes. Those who sign inform consent their data is collected prospectively.

In Finland, pregnant women enter universal, free maternity health care services during first trimester, and are followed up regularly throughout pregnancy. Maternity clinic nurses evaluate PPD symptoms using the Edinburgh Postnatal Depression Scale (EPDS). A woman identified with possible clinically significant symptoms (EPDS ≥ 10) is referred for a maternity clinic physician evaluation to assess need for mental health treatment, and as needed women are referred to a psychiatric outpatient unit.

In this study data were collected through the delivery ward and also with the use of patient's self-report survey data. Current obstetrics relevant information (e.g., delivery complications, delivery week, newborn sex, newborn health) were entered into an electronic database by a

nurse in the delivery ward. First trimester EPDS was also entered by nurse and obtained during patient's ward visit. Additionally, as part of clinical care, women completed a clinical background questionnaire concerning history of health condition (e.g. history of obstetrical complications and mental health disorders) as well as current weight and height. Subsequent EPDS scores were obtained for study purposes.

The sample extracted from the 2017 dataset included 4145 women representing participation rate of 37% of the women approached. Consented subjects were registered in the KuBiCo database and their maternity health care data was collected as well as biological samples. Participants were also asked to complete electronic questionnaires concerning their physical health and wellbeing. The Central Finland Health Care District research ethics committee approved the study protocol. Data was collected at three time points: first trimester (6–12 gestation weeks, average = 10 wks weeks, Time 1), third trimester (28–43 gestation weeks, average = 36wks, Time 2) and again in the early postpartum period (at 8 weeks postpartum, Time 3).

The sample used in this study included 824 participants who provided PPD symptom data and other variables in at least two waves of assessment. 26.6% of this sample who completed all three assessments. Their mean age was 30.2 (SD = 5.06); close to a half (47%) were primiparas and a significant number (37%) lived with a partner. The majority was of Finnish nationality (98%) and delivered at term (94%) undergoing a vaginal delivery (87%). 8.4% (n = 69) reported history of maternal mental health disorders. The final sample did not differ significantly from the original sample in background information except that the final sample was slightly older (M: 30.2 years vs. 29.8 years; Z = - 2.20, p = .03).

2.2. Measures

PPD symptoms in the perinatal and postnatal period were assessed at all the three time points using the EPDS (Cox et al., 1987; Pop et al., 1992) in a translated Finnish version. The EPDS is the most commonly used measure of depression during the antenatal and postnatal period. The EPDS consists of ten items indicating how the woman felt during the previous week on a 0–3 point scale with total scores ranging between 0 and 30. Higher scores indicate more severe symptoms of depression. Scores of 10 or higher suggest PPD symptoms at a clinical level (Bodenlos et al., 2016). Cutoff value EPDS ≥10 is reported to produce adequate sensitivity and specificity (Bergink et al., 2011; Matthey, 2008). Thus, in the current study, an elevated total EPDS score of 10 and above was defined as "probable PPD". Cronbach's alphas for total scores at the three time points ranged between 0.83 and 0.85.

The following information was also assessed: demographics: maternal age in birth (in years), family status (married, unmarried), and first labor (yes, no); history of maternal mental health disorders (yes, no), and mental disorders in mother's family (yes, no); body mass index (BMI) at the beginning of pregnancy (calculated from self-reported weight and height, kg/height^2), weight and weight gain during pregnancy (in kg), and maternal relative weight gain (in %) during pregnancy, in accord with literature on BMI and PPD (Bodnar et al., 2009); fear of birth (yes vs no, based on clinician evaluation in accord with ICD classification); history of complications in pregnancy (i.e., sum of stillbirths, miscarriages, hypertension, and abortions), which have been previously linked with PPD (Thombre et al., 2015); complications in delivery (i.e., sum of vacuum-assisted delivery, Caesarean section, asphyxia, placental abruption, placenta previa, hepatosis, amnionitis, oligohydramnion, polyhydramnion, and surgically scarred uterus), which are also suggested to contribute to PPD (Olieman et al., 2017; Strapasson et al., 2018); preterm birth (yes, no based on birth before 37 gestation weeks); number of fetuses (twin vs. singleton); newborn sex (boy, girl), newborn health [APGAR score at 1 and 5 min after parturition ranging from 0 to 10 (0–6 indicating high risk for medical complications in newborn, and 7–10), and small newborn weight (defined as < 2500 g).

2.3. Statistical analysis

We include in the analyses only the participants (N = 824) who provided data in at least 2 waves. Overall, 20.3% of the data were missing. Little's (1988) Missing Completely At Random (MCAR) test, has indicated that the data were missing completely at random, $\chi^2_{(79)} = 80.81$, p = .422. To eliminate possible biases and to avoid loss of statistical power resulting from missing data, the robust full-information maximum-likelihood (FIML) estimation procedure was employed to handle missing data, based on the assumption that missing data were MCAR. The appropriateness of FIML is widely endorsed.

Growth mixture modeling (GMM) was applied to identify discrete clusters of PDD growth symptom trajectories. This method is recommended to identify heterogeneous subpopulations that comprise distinct response trajectories across time (Feldman et al., 2009). One-to five-cluster unconditional models (i.e., without covariates) were first tested for PPD symptoms. The best fitting model was selected based on the lowest information criteria (BIC and sample-sized adjusted BIC), a high entropy (close to 1.0), and statistically significant p values for both the Lo-Mendell-Rubin (LRT) and bootstrap likelihood ratio test (BLRT). Then, a series of nested analyses were further conducted on the cluster solution to identify possible covariates that might improve model fit and accuracy of classification. Demographic and questionnaire variables were entered as covariates to create conditional models, including maternal mental health, mental health history in maternal family, history of complications in pregnancy, maternal age, BMI, fear of birth, preterm birth, APGAR scores, and percentage of weight gain. Only variables whose inclusion allowed for model convergence and improved model fit were retained.

Analyses of variance (ANOVA) were performed to examine differences between class trajectories in demographic and quantitative health-related and childbirth-related measures (i.e., maternal age, maternal weight in pregnancy and BMI and weight gain, number of fetuses, history of pregnancy complications, and current delivery complications). Chi-square tests were performed for independence of measures to examine differences in qualitative demographic and health-related measures (i.e., family status, history of mental health disorders in mother's family, maternal mental health disorder, first labor, fear of birth, preterm delivery, sex of the newborn, APGAR score, and small newborn weight).

We employed Monte Carlo method to estimate significance. Šidák (1967) adjustment was employed to account for Type I error inflation because of multiple comparisons and also as the post-hoc tests. To further examine possible differences between delayed PPD and resilient trajectories we conducted a logistic regression analysis with trajectory classification as the dependent measure and main study measures as predictors. All analyses were performed using SPSS 21.0 and MPLUS 6.1.

3. Results

3.1. Prevalence and trajectories of PPD class

The prevalence rates of least probable PPD (i.e., scores above 9) were 4.9% at T1 (M = 12.33, SD = 2.69), 10.1% at T2 (M = 12.53, SD = 3.11), and 12.4% at T3 (M = 12.94, SD = 3.09). Out of the 10.1% (N = 83) cases with least probable PPD at T2, 9.0% (N = 74) were new cases. Similarly, out of the 12.4% (N = 102) cases with least probable PPD at T3, 6.9% (N = 57) were new cases (i.e., not meeting score for least probable PPD at T1 or T2). McNemar tests for examining the change patterns in PPD over time have revealed major shifts in PPD from T1 to T2 (McNemar-Bowker's $\chi^2_{(1)} = 18.78$, p < .001), but no significant shifts from T2 to T3 (McNemar-Bowker's $\chi^2_{(1)} = 3.49$, p = .09) (see Table 1). Out of the women without PPD at T1, symptoms worsened at T2 for 9.4% and they were classified as probable PPD (N = 74). Conversely, for 77.5% (N = 31) of participants with probable

Table 1
Change in PPD status between assessment points.

		T2	
		None	Probable
T1	None	**90.60%**	9.40%
	Probable	77.50%	**22.50%**
		T3	
		None	Probable
T2	None	**91.10%**	8.90%
	Probable	56.60%	**43.40%**

Note: PPD = peripartum depression. Probable PPD defined as score > 9 on the Edinburgh Postnatal Depression Scale (EPDS).

Table 2
Fit indices for one-to eight-cluster Growth Mixture Models for PPD symptoms (Unconditional).

Fit indices	1 cluster	2 clusters	3 clusters	4 clusters	5 clusters
BIC	12912.03	12751.27	12649.19	12618.65	12609.92
SABIC	12886.63	12716.34	12604.73	12564.67	12546.41
Entropy		0.94	0.89	0.89	0.86
LRT p value		< .001	= .002	= .049	= .187
BLRT p value		< .0001	< .0001	< .001	= .198

Note: BIC = Bayesian information criterion, SABIC = sample size adjusted Bayesian information criterion, LRT = Lo-Mendell-Rubin test, BLRT = bootstrapped likelihood ratio test. PPD = peripartum depression.

PPD during pregnancy, the condition became better and they were no longer classified as probable PPD in T2.

GMM analysis showed that for an unconditional modeling a four-cluster (i.e., trajectory) solution was optimal (see Table 2). Fig. 1 illustrates mean values of PPD scores for each trajectory class at each time point. Based on the time-varying changes in PPD status, the four clusters were labelled as *chronic PPD* (1.1%; class 3), *delayed-onset PPD* (10.2%; class 2), *recovered* (7.2%; class 4), and *resilient* (81.5%; class 1).

The model indicated that more PPD symptoms at T1 (which was set as baseline), was linked with suffering from a history of mental disorders ($\beta = 0.30$, $p < .001$), a family history of mental disorders ($\beta = 0.15$, $p = .002$), history of more pregnancy complications ($\beta = 0.28$, $p < .001$), younger age ($\beta = -0.14$, $p < .001$), higher BMI ($\beta = 0.15$, $p = .001$), and higher weight gain ($\beta = 0.13$, $p = .003$; in %). In addition, the model revealed that greater increase in PPD symptoms over time was associated with older age ($\beta = 0.17$, $p < .001$) and fear of birth ($\beta = 0.14$, $p = .046$) but also with a history of fewer pregnancy complications ($\beta = -0.19$, $p = .003$) and at-term delivery (as opposed to preterm delivery; $\beta = -0.22$, $p = .001$). The latter two results may be related to the findings that women with more
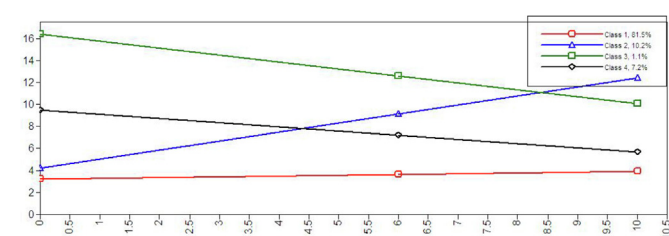

Fig. 1. Mean values of peripartum depression (PPD) symptom scores for each trajectory class at each time point. Most women were resilient to PDD (resilient, class 1). A small number of women had a chronic state of PDD that began prior to delivery and continued postpartum (chronic, class 3). The forthcoming delivery evoked PPD in some women, which continued postpartum (delayed-onset, class 2), and for others symptoms improved drastically over time (recovered, class 4).

pregnancy complications and who gave birth preterm ($\beta = 0.18$, $p = .001$) were higher on PPD symptoms already at baseline.

3.2. Predictors of PPD trajectory class

Means and standard deviations are presented in Table 3 for examining differences between PPD trajectories in demographics and health and childbirth-related factors. Analyses indicated that the PPD trajectories significantly differed on a number of factors including number of fetuses and delivery complications. Specifically, the chronic PDD had more fetuses than the other classes; the chronic PPD and recovered classes had significantly more delivery complications.

Significance of the chi-square tests for independence of measures is presented in Table 4. Analyses revealed differences in the prevalence of history of mental health disorders in mother's family and small newborn weight (marginally significant). Specifically, the chronic PPD had higher rates of mental health disorders in family than the other trajectory classes; the chronic PDD and recovered had significantly more incidents of small newborn weight.

Finally, logistic regression analysis revealed that the delayed PPD had significantly more history of pregnancy complications and greater prevalence of maternal mental health disorders than the resilient class (see Table 5).

4. Discussion

We raise two competing notions on the course of PPD. The static view posits that PPD symptoms remain persistent and relatively stable with the passage of time. A more recent, dynamic view regards changes and variability in PPD status over time (Dekel et al., 2014). We explored prediction from these theories by measuring the PPD symptom trajectories from early pregnancy to the first two months after childbirth in a large, prospective sample. Because women may exhibit various PDD classes rather than a homogenous trajectory, we employed a person-centered statistical approach to tap into the various symptom trajectories.

We found that the majority of women (81.5%) appear to cope well and their symptom-free response is likely to remain steady over time. Elevated persistent PPD symptoms across pregnancy and childbirth were documented only in a significant minority (1.1%) of women. In fact, our data reveals that significant changes in PPD symptom severity can occur. For some women the symptoms appear to improve over time and they no longer endorse symptoms at a clinical level.

We found four classes of PPD symptoms from pregnancy through the early postpartum period that are separable with distinct correlates. The classes include: chronic elevated (chronic) and stable-low symptoms (resilient) over time, as well as emerging (delayed-onset) and improving (recovered) symptoms. This observation of empirically discrete PPD responses to pregnancy and childbirth accords with recent studies applying a person-centered approach (Guyon-Harris et al., 2016; Luoma et al., 2015). As we show here, a resilient response characterizes the experience of most women and only a small group of women endorse persistent and chronic elevated PPD symptoms, in accordance with previous work (Evans et al., 2001). Our finding of a PPD rate of 12% is also consistent with several studies (Allbaugh et al., 2015; Ashley et al., 2016; Castro e Couto et al., 2016; Lara et al., 2015; Quispel et al., 2014).

Fluctuations in PPD symptom severity during the perinatal period have received less attention. Our findings indicate that more than two-thirds of women who endorsed probable PPD in early gestation did not endorse PPD in late gestation. A similar trend in symptom improvement was found between late peripartum and early postpartum such that around half of women with probable PPD did not endorse PPD eight weeks following parturition. This symptom improvement in the postpartum period has been previously reported (Evans et al., 2001). Consideration of symptom fluctuations may call for PPD screening at

Table 3
Means and standard deviations for examining differences between PPD trajectory classes in quantitative measures.

	Chronic ($N = 9$)		Delayed-onset ($N = 83$)		Recovered ($N = 55$)		Resilient ($N = 677$)		$F_{(3, 820)}$	η^2
	M	SD	M	SD	M	SD	M	SD		
Maternal age at birth	27.22	4.63	29.83	5.68	29.60	4.28	29.91	4.75	0.97	.00
Maternal weight	70.89	10.29	70.37	18.11	66.78	14.25	67.76	14.53	1.00	.00
Maternal BMI	25.33	4.77	25.22	5.86	24.16	5.32	24.30	4.91	0.97	.00
Number of fetuses	1.44[a]	0.53	1.12[b]	0.33	1.27[b]	0.50	1.18[b]	0.38	3.17*	.01
Maternal weight gain (kg)	15.15	3.83	13.59	4.89	13.62	5.04	13.48	4.80	0.37	.00
Maternal weight gain (%)	21.82	7.14	20.20	8.60	20.92	8.46	20.37	8.03	0.19	.00
History of pregnancy complications	0.00	0.00	0.28	0.53	0.33	0.51	0.26	0.49	†1.27	.01
Delivery complications	4.22[a]	1.56	1.52[b]	1.85	3.85[a]	1.58	2.16[c]	2.09	†26.34***	.06

Note: PPD = peripartum depression. † = Brown-Forsythe adjustment because of asymptotically distribution. Mean scores with different superscript letters ([a,b,c]) are significantly different from each other (for example, for the variable number of fetuses, the chronic PPD had significantly more fetuses than the other classes, as indicated by mean a superscript "a" in contrast to other classes with mean superscript "b" and p < .05.).
***p < .001, *p < .05.

Table 4
Prevalence differences between PPD trajectory classes.

	Chronic ($N = 9$)	Delayed-onset ($N = 83$)	Recovered ($N = 55$)	Resilient ($N = 677$)	$\chi^2_{(3)}$	p_{mc}
Mental health disorders in maternal family (% yes)	44.4%[a]	16.9%[b]	10.9%[b]	13.1%[b]	8.48*	.040
Maternal mental health disorder (% yes)	11.1%	15.7%	9.1%	7.5%	6.40	.091
First labor (% yes)	55.6%	53.0%	61.8%	52.4%	1.82	.615
Fear of birth (% yes)	11.1%	3.6%	1.8%	4.1%	1.93	.569
Maternal preterm delivery (% yes)	0.0%	3.6%	0.0%	3.0%	2.11	.544
Sex of the newborn (% girl)	33.3%	44.6%	50.9%	51.1%	2.31	.510
Apgar 1 min (% 0–6)	0.0%	4.8%	0.0%	5.2%	3.47	.278
Apgar 5 min (% 0–6)	0.0%	3.6%	0.0%	2.4%	2.15	.562
Small newborn weight (% yes)	44.4%[a]	22.9%[b]	38.2%[a]	24.7%[b]	6.88	.075
Family status (% unmarried)	44.4%	43.4%	38.2%	43.0%	0.51	.925

Note. PPD = peripartum depression. p_{mc} = Significance by Monte Carlo method. Rates in the tables indicate the % of participants in a given class which endorsed the variable. Rates with different superscript letters ([a,b]) are significantly different (for example, rate with the superscript "a" is different from rate with "b", indicating that the chronic and recovery classes had more incidences of small newborn rate than the delayed and resilient classes). $\chi^2_{(3)}$ = chi-square value (degrees of freedom are listed in parenthesis).
*p < .05.

Table 5
Logistic regression coefficients and odd ratio for examining the likelihood to be classified as delayed and resilient PDD trajectory classes.

	b	SE	Wald	OR
Delivery complications	−0.02	0.23	0.01	0.98
History of pregnancy complications	−0.17	0.07	5.89*	0.84
Maternal age	−0.01	0.03	0.21	0.99
Mental health disorders in maternal family (% yes)	0.07	0.34	0.04	1.07
Maternal preterm delivery (% yes)	0.28	0.64	0.20	1.33
Sex of the newborn (% girl)	−0.26	0.24	1.21	0.77
Apgar 1 min (% 0–6)	−0.78	0.88	0.78	0.46
Apgar 5 min (% 0–6)	1.11	1.04	1.14	3.04
Small newborn weight (% yes)	0.19	0.32	0.35	1.21
Maternal mental health disorder (% yes)	0.73	0.37	3.85*	2.07
Family status (% unmarried)	0.02	0.24	0.01	1.02
Fear of birth (% yes)	0.02	0.02	0.76	1.02
Maternal weight gain (%)	−0.24	0.64	0.14	0.79
Maternal BMI	0.04	0.03	2.57	1.04

Note. PPD = peripartum depression. Significant Wald refers to classification as delayed-onset.
*p < .05.

several time points to target the significant minority of women whose symptoms do not improve over time and those who experience a delayed-onset. The existence of persistence symptoms supports the current implementation of peripartum screening to prevent adverse responses (Guyon-Harris et al., 2016).

Our findings reveal distinct predictors associated with the PPD trajectory classes. The findings of more mental illness in family of origin among women with chronic symptoms accord with previous work on the strong contribution of history of mood disorder in the family to PPD etiology (Jones and Craddock, 2007). Mental illness in the family may suggest a biological predisposition for developing chronic PPD although there are also adversity and environmental contributing factors (Denckla et al., 2017). Our findings further reveal that complications in delivery are associated with chronic PPD, which accords with recently reports of obstetrics complications and increased PPD response (Postpartum Depression: Action Towards and Treatment, 2015). Interestingly, as we show here, delivery complications were also characteristic of a recovery response. Thus, childbirth-related distress may promote positive postpartum adaption in accord with the literature on posttraumatic growth (Dekel et al., 2012; Tedeschi and Calhoun, 2004) and personal growth resulting from childbirth (Taubman–Ben-Ari et al., 2018).

Several limitations in this study should be noted. The sample size is smaller than the original study, and the overall participation rate warrants attention as well as the sub-group of number of participants in the emerged classes. Volunteering without compensation and completing assessment during a busy time period (expecting or having a newborn) in part may account for study response rate. Although rates of PPD accord with national data, it may be that participants in this study differed from original sample, and that the current sample included women who were more likely to endorse PPD or less likely to have symptoms. Although we measured PPD symptoms with the widely used self-report EPDS, we did not have information available on diagnoses of PPD or treatment or history of PPD diagnosis. While we assessed PPD symptoms at three time points, other observed changes in symptoms may occur at a different interval time. We cannot fully rule out that a woman classified as recovered from her symptoms will not have

relapsed given a subsequent forth assessment. Changes in PPD status suggest that multiple, frequent assessments of PPD symptoms could better capture the course of symptoms over time. The inclusion of a larger sample would allow for the detection of larger trajectory classes to examine differences on multiple variables. We assessed for obstetrical factors related to PPD trajectory (Postpartum Depression: Action Towards and Treatment, 2015), but other factors might also be important to examine including the effect of treatment and birth experience on symptom course. Additionally, as our analysis focused on possible changes in PPD, co-morbid symptoms of anxiety and posttraumatic stress disorder (Dekel et al., 2017) were not explored. Ideally, a prospective, longitudinal investigation of PPD and comorbid peripartum and postpartum symptoms utilizing large samples would provide further insight.

In conclusion, the current study is the first to take a person-centered approach to examine the various trajectories of depression symptoms from the very first months of pregnancy and across childbirth. The findings demonstrate drastic fluctuations in PPD symptom levels over time rather than a pattern of stability. For a significant number of women, PPD may improve in the perinatal period.

Increasing awareness of the dynamic course of PPD symptoms in routine clinical care may facilitate a personalized medicine approach in peripartum mental health treatment. Our findings call for repeated assessment of a woman's depression level as part of routine obstetrics care. Close monitoring of symptom change to detect new PPD cases early on and symptom improvement would benefit mother and child. Future research to support PDD screening utilizing a woman's predicted symptom trajectory based on psychological and biological indicators is warranted.

Declarations of interest

None.

Disclosures and acknowledgments

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